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## PALAEOSYOPS AND ALLIED GENERA.

BY CHARLES EARLE.

The present preliminary notice is the result of an investigation of the *Palaeosyops* material contained in the Princeton collection. This material was collected by the various Princeton exploring parties, and is from the middle Eocene; partly from the Bridger, and partly from the Washakie division of this epoch.

The genus *Palaeosyops* was established by Leidy.<sup>1</sup> Since then Marsh, Cope, Scott and Osborn have made contributions to the same and allied genera. They have all felt the want of abundant material in their descriptions, and in most cases the original types described by them have never been compared, and thus one finds the confusion in the nomenclature a great obstacle. Another difficulty has been, to co-ordinate various portions of skulls and scattered teeth with each other and with the limb-bones. I have been greatly assisted by a part of an individual of *Palaeosyops paludosus* in the Princeton Collection, associated with a portion of the skull, and the bones of a posterior limb, nearly complete. During the course of this investigation I have been enabled to study the original types in the National Museum, in the Academy of Natural Sciences of Philadelphia, and in the Yale College Museum.<sup>2</sup> I am also indebted to Prof. Cope for allowing me to examine his collection; so that I am now in a position to bring together the work of the several authors, and to give, as well as the present known material will allow, a preliminary descriptive analysis of the forms above referred to.

NOMENCLATURE. Cope, in his Tertiary Vertebrata, has shown the relation of the nomenclature of *Palaeosyops* and *Limnonyx* proposed by Marsh and Leidy, and there is no question as to Leidy's priority. Leidy described the genus *Palaeosyops* three months before Marsh published his preliminary notice, in which he describes his *Palaeosyops laticeps*. Cope did not attempt to determine the original types of Leidy from which the genus and species, *Palaeosyops paludosus*, was first indicated. After studying Leidy's original specimens, now in the

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<sup>1</sup> Proc. Acad. Nat. Sci. Phil. 1870, p. 113.

<sup>2</sup> I wish to express my thanks to Prof. G. Brown Goode, Prof. Angelo Heilprin, and Prof. O. C. Marsh for these privileges.

National Museum, which he described,<sup>1</sup> and which later he figured.<sup>2</sup> I am convinced that they belong to the large species of *Palaeosyops*, namely that which Leidy subsequently named *P. major*. Second: that the smaller forms later referred by Leidy to *P. paludosus* were quite distinct from his types of this species. Therefore, as the original specimens were called *P. paludosus* and as they were identical with a form which he later called *P. major*, the latter name is a synonym and must drop out. As Leidy's name *P. major*, was very convenient in designating the relative size of the two species, we propose to call the smaller form *Palaeosyops minor*—the *P. paludosus*, according to the later use of Leidy, and others.

I may also add that Cope's *P. laevidens* is a different form from this smaller species of Leidy, so that Cope's specific name cannot be used.

Cope<sup>3</sup> accepts Marsh's statement that the original specimens figured by Leidy belong to *Limnohyus*; this is, I think, an error as the teeth are much larger, and correspond in every respect with Leidy's *P. major*. Marsh's statement that the teeth of his *P. laticeps* have the same general structure as Leidy's smaller species—namely his *P. paludosus*, is also incorrect. I have examined both types, and I shall show later that the two forms are quite distinct—one approaching the *Telmatotherium* form of molar, the other type being more like the typical molar found in *P. paludosus*. Marsh's type of his genus *Telmatotherium*<sup>4</sup> agrees in all particulars with the type of Scott and Osborn's *Leurocephalus*,<sup>5</sup> so that the latter genus must become a synonym of *Telmatotherium*. Scott and Osborn's species *T. (L.) cultridens*, I retain as a good species, and it has very interesting characters which place it rather lower in the scale than the *T. validus* of Marsh. The skull figured by Scott and Osborn in their report for 1877 as *P. paludosus*, should be referred to Marsh's genus *Limnohyops*. Its general form is very different from *Palaeosyops*, as will be shown later. After carefully considering the matter of uniting the various genera into one, I am of the opinion that

<sup>1</sup> Op. cit., p. 113.

<sup>2</sup> U. S. Geol. Survey of the Ter., Vol. I, 1873, Plate V, fig. 5, and pl. XXIII, figs. 3-6

<sup>3</sup> Tertiary Vertebrata, p. 698.

<sup>4</sup> Am. Jour. Science and Arts, vol. IV, pub. July 22nd, 1872.

<sup>5</sup> E. M. Museum Bulletin. No. 1, Report Princeton Scientific Expedition Sept. 7th, 1878.

*Telmatotherium* may be retained, and that *Limnohyus*, or as it is now called, *Limnohyops*, should not have a generic value equal to that of *Telmatotherium*.

The type specimen of the genus *Limnohyops* is very closely related to that of *Palaeosyops* in the teeth structure, and we have good reasons for supposing that the presence of the hypocone on the last superior molar is a transition character, which is not available for generic definition. The presence of a rudimentary hypocone on the last superior molar of *Palaeosyops paludosus* is not an uncommon occurrence. The premaxillary regions of *Limnohyops* and *Palaeosyops* are identical although the skull contours are very different. The generic reference of Leidy's smaller species of *Palaeosyops*, our *P. minor*, is uncertain, very little being known of the skull or of the limb bones. The characters of the molars (see his figs., Pl. IV, figs. 3-6) are closely similar to those of *Telmatotherium*, they have the square form observed in that genus.

We may now give a brief diagnosis of the more important characters of the different genera and species, and also add an analytical table for comparison:—

I. Last superior molar with only one internal cone.

A. External lobes of superior premolars separated PALAEOSYOPS.

a. size, large.

Inferior molars stout and broad, post. tubercle a cone

*P. paludosus.*

Inferior molars high and long, post. tubercle a cone *P. validens.*

b. size, medium.

Superior premolar II with one external lobe *P. laevidens.*

Superior premolar II with two external lobes *P. minor.*

c. size, small.

Superior premolar IV with a protoconule *P. borealis.*

B. External lobes of superior premolars straight.

TELMATOTHERIUM.

a. sup. premolar II with rudimentary internal lobe

*T. cultridens.*

b. sup. premolar II with internal lobe

*T. validus.*

II. Last superior molar with two internal cones LIMNOHYOPS.

a. size, large.

Hypocone of last upper molar one half size of protocone

*L. laticeps.*

b. size, small.

Hypocone of last upper molar about equal to protocone

*L. fontinalis.*

*Incertae sedis.*

Symphysis of lower jaw extremely long and narrow

*P. hyognathus.*

Distal extremity of nasals expanded

*P. megarhinus.*

**PALAEOSYOPS** Leidy (= *Limnohyus* Marsh).

*P. paludosus* Leidy, type species—type specimen in National Museum. (Synonyms *P. major* Leidy).

1. *P. minor*, Earle, sp. nov.

Type specimen=specimen referred to *P. paludosus* by Leidy in Museum of Academy of Natural Sciences of Philadelphia.

2. *P. laticeps*, Marsh.

Type, skull, etc., in Yale College Museum.

The following diagnosis may define *Palaeosyops*:

Last superior molar usually with one internal cone.

Intermediate tubercles well developed.

Crowns of molars not prominent.

External cusps of superior premolars separated.

Second superior premolar with a well defined internal lobe.

The form of the superior molar in this genus is very characteristic, and differs quite radically from that of *Telmatotherium*. The transverse diameter of the tooth is greater than the antero-posterior. The external V's are round and shallow. The anterior buttress is widely prolonged. The median buttress is not constricted off; there is generally no external cingulum. The crowns of the teeth are low, and the intermediate conules are strongly developed. Marsh has

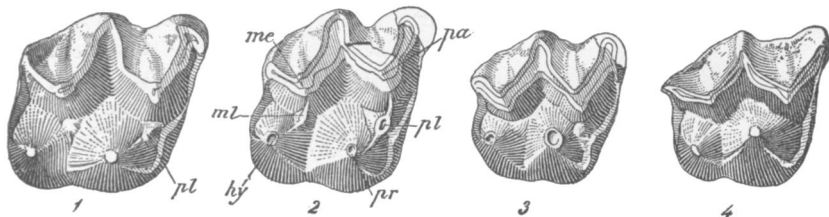


Fig. 1.

Second superior molar of

1. *Palaeosyops paludosus* Leidy. 2. *Limnohyops laticeps* Marsh. 3. *Palaeosyops minor* Sp. nov. and 4. *Telmatotherium cultridens* S. & O.  $\frac{2}{3}$  natural size. pa.=paracone, me.=metacone, pr.=protocone, hy.=hypocone, pl.=protoconule, ml.=metaconule.

pointed out the difference between the premaxillary regions of *Palaeosyops* and *Telmatotherium*. In the former genus the premaxillaries are short and depressed, their symphysis is very short and round, their anterior aspect is convex. The zygomatic arch in *Palaeosyops* is strong and decurved, and the form of the head is more like that of the Tapir than in the other genera.

1. *Palaeosyops paludosus* (Leidy.)

Syn. (*P. major* Leidy) (*Limnotherium robustus* Marsh.)

Protoconules of superior true molars large, and always present, external cingulum absent.

Transverse diameter of first superior molar greater than that of last premolar, posterior tubercle of last inferior molar cone-like, and median in posterior.

This is the largest species of the genus. It was, as we have seen, first described as *P. paludosus*, and later, from more abundant material, was designated as *P. major*.

The teeth of *P. paludosus* are very large, being wide and rather short, the external V's are characteristic of the species, being shallow, with very prominent anterior buttresses on the true molars, their median buttress is not constricted off, but is rounded and open internally. The intermediate conules of *P. paludosus* are very strongly developed, the external lobes of the superior molars are entirely without a cingulum, their anterior cingula are present, and the internal cingula incomplete. The last three premolars have well developed internal cones, with generally incomplete internal cingula, the external lobes of the last premolar are equal, and the premolars are not provided with the prominent cingula seen in *Telmatotherium*. The inferior molars are short and broad, with low crowns. The last inferior molar is a very characteristic tooth in the species: it is very short and heavy, its posterior tubercle is much smaller than the anterior portions of the tooth, is placed median in relation to the external lobes, and is not provided with the strong lateral crests and median valley seen in *Telmatotherium*. The skull in *P. paludosus* is broad and massive, its posterior portion is quite like that of the Tapir, the frontal region being higher than the occipital, but differing very much from that of the Tapir in the nasals, which were short and broad, and reached so far forward as to overhang the premaxillary symphysis. From the structure of the facial region, I conclude that this species was provided, if at all,

with a very rudimentary proboscis. The malar insertion is gradual and not abrupt as seen in other species of the family. The auditory processes were distinct, the post glenoid being long and rather stout; the internal glenoid process is wanting in this species, and the paroccipitals were provided with a terminal styloid process.

The symphysis of the lower jaw is rather short, the posterior third of the lower border of jaw strongly inflected, with the angle of the same turned outwards.

**2. *Palaeosyops laevidens* Cope.<sup>1</sup> (not *P. paludosus* Leidy.)**

Second superior premolar with only one external lobe, external lobes of true molars without cingula. Crowns of molars low.

This species was described by Prof. Cope from the characters of the second premolar as above defined. Prof. Cope himself was not certain that his species was distinct from Leidy's form, but I have examined both of the types and find them quite different. Cope's *P. laevidens* has the molar form of a typical *Palaeosyops*, and not the square shaped tooth of *Telmatotherium*, which the smaller species of Leidy so closely resembles.

**3. *Palaeosyops borealis* Cope.<sup>2</sup>**

Molars of a square form with traces of transverse ridges, intermediate conules small, last superior premolar with well marked protoconule, size very small.

This, I believe, is the only species of *Palaeosyops* from the Wind River Eocene, it is very much smaller than the other forms, being perhaps about one-half the size of *P. paludosus*.

**4. *Palaeosyops vallidens* Cope.<sup>3</sup>**

Molars long and narrow with high crowns, posterior tubercle of last molar a cone, inferior border lower jaw straight and not inflected.

The lower jaw figured by Cope<sup>4</sup> will form the type of this species. Prof. Cope also figured a series of upper molars under the name of this species. He speaks of this series and the lower jaw not being

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<sup>1</sup> Annual report U. S. Geol. Survey Terr. 1872 (1873) p. 591.

<sup>2</sup> American Naturalist, 1880, p. 746.

<sup>3</sup> Palaeontological Bulletin No. 7, p. 1, Aug. 22nd, 1872.

<sup>4</sup> Tertiary Vertebrata, Pl. 52, fig. 3.

found together, and concludes that they probably belong to different species. I agree with him in this view, and consider that the superior molars should be referred to Marsh's form of *Telmatotherium validus*, as they have all the general characters of that species, and differ from *T. cultridens* in having a well defined internal lobe to the second superior premolar.

The last molar in the jaw above referred to is interesting, as it shows in some respects transition characters between *Palaeosyops* and *Telmatotherium*.

5. *Palaeosyops minor*, sp. nov.

Second superior premolar with two external lobes, external lobes of last superior premolar equal. Intermediate conules of true molars reduced, a strong external cingulum present.

*P. minor* embraces specimens which Leidy erroneously described as *P. paludosus*, figs. 3-6, Plate IV of Leidy's report for 1873. The material relating to this species is very scarce, being mostly represented by scattered teeth, and one complete series of upper molars in the Academy of Natural Sciences of Philadelphia. There is also in the collection, a lower jaw with teeth nearly complete, which Leidy referred to this species. Leidy figures a series of upper molars with a portion of the facial region attached. This specimen I have not been able to see. I believe it is in a private collection. The following molar characters will be seen to be closely similar to those in *Telmatotherium*.

The molars in *P. minor* have their axes about equal, thus producing a square tooth as is found in *Telmatotherium*. The external V's are broad and angular, their median buttresses are deeply constricted off, the anterior buttress being not widely prolonged as in the largest form. The teeth have rather high crowns and the external face is provided with a well marked cingulum. The intermediate conules in this species are not strongly marked. The transverse diameter of the last premolar is about equal to that of the first true molar; all the premolars have incomplete internal cingula, the internal lobes of the premolars are more pointed than in *P. paludosus*, and are apt to be concave toward the external side.

I have examined two series of upper molars of this species<sup>1</sup> and in both cases the second superior premolar was provided with two well

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<sup>1</sup> Leidy figures (op. cit. pl. IV, figs. 3-4) a series of superior molars of this species, in which the second premolar has only one external lobe?



defined external lobes, so that Cope's *P. laevidens* does not come within the definition of this species; then again the form of the molars, the presence of strong cingula, etc., differ very much from those in Cope's species. I am able to add nothing to the skull characters, as the material that I have examined contained no skulls

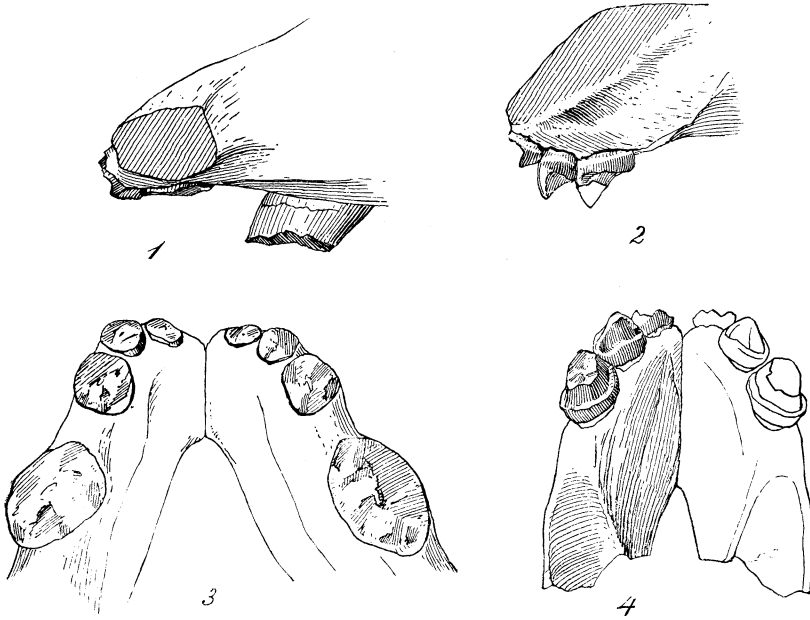


Fig 2.

Internal and ventral view of the premaxillary region 1 and 3, *Palaeosyops paludosus* Leidy. 2 and 4, *Telmatotherium cultridens* S. & O.

referable to this species, and, in fact, I may add here that this is not the common species of *Palaeosyops*, the species *P. paludosus*, above described, being the most common form.

#### LIMNOHYOPS Marsh

(embraces *Palaeosyops* as employed by Marsh, *Limnohyus* as employed by Leidy and others).

Molars with low crowns, rounded external lobes, well developed intermediate tubercles, well marked, transverse crests may be present on superior molars, the last upper molar with two internal cones.

1. *Limnohyops laticeps* Marsh.

(Syn. *Palaeosyops laticeps* Marsh, and *Limnohyus laticeps* Leidy).

Protocone of last superior molar twice the height of hypocone. Paracone of last superior premolar much larger than metacone.

This species has been placed under several genera, Marsh having overlooked Leidy's earlier description. It has now been placed in the genus *Limnohyops*.<sup>1</sup> The teeth characters of *Limnohyops* are very different from those of Leidy's smaller species of *Palaeosyops*. I differ from Prof. Marsh in supposing that Leidy's original type belonged to *Limnohyus*. I have shown above the true position of the original specimens.

We are fortunate in having in the Princeton collection a skull of this genus, with the occipital region complete. There are also a few teeth in the collection, which I refer to this genus. The dentition of this species is closely allied to *P. paludosus*. The teeth have low crowns without external cingula, the external V's are shallow, and round, and have the general characters of the above species, the intermediate conules in the species are well developed. One character found in this species quite different from that in *P. paludosus* is that well defined transverse ridges are developed, connecting the internal cones with the external lobes of the molars. These ridges are small, but plainly to be seen. The hypocone of the last upper molar is much smaller than the protocone. The presence of the hypocone on the last molar (as already spoken of) I consider as transitional, arising from a condition found in *P. paludosus*, where this cone is often rudimentary. The transverse diameters of premolar 4 and molar 1 are nearly equal, differing in this respect from those in *P. paludosus*. The skull contour of *L. laticeps* is very different from that of *P. paludosus*. The occipital region is higher than the frontal, resembling in this respect the *Rhinoceros*. The sagittal and lambdoidal crests are extremely heavy, and widely overhang the supra-occipital region. The nasals are more slender and longer than in *P. paludosus*. The premaxillaries resemble those found in *P. paludosus*, being short and depressed with a very short symphysis. The malar insertion is abrupt with the middle portion of the arch rounded, the infra-orbital foramen is exposed. The zygomatic arch is wide spreading and heavy. The post glenoid process is rather long and curved forward. An internal glenoid process is present in

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<sup>1</sup> Am. Journ. Science, June, 1890, page 525.

this species. The post-tympanic process is broad and separated from the glenoid. The occipital region is low, broad and deeply concave superiorly. The carpus in *L. laticeps* is very characteristic, being much lighter than *P. paludosus*, with the facets and axis of the same arranged differently. *L. laticeps* was probably about the same height as *P. paludosus*, but was a more agile and slender form.

**2. *Limnohyops fontinalis* Cope.<sup>1</sup>**

Internal cones of last superior molar nearly equal. First upper molar much smaller than second, size small.

This is a strongly marked species, being about one-half the size of *L. laticeps*. The form of the skull in *L. fontinalis* closely resembles that in *L. laticeps*, although more depressed than in that species. The malar insertion is similar to the above form with an exposed infra-orbital foramen. We consider Cope's *L. diaconus* not a good species.

**TELMATOTHERIUM Marsh.**

(Syn. *Leurocephalus* S. & O.)

Incisors with strong basal ridges. Canines compressed with sharp cutting ridges. Molars resembling *Palaeosyops*, but with higher and more pointed crowns, the intermediate tubercles may be nearly wanting in this genus, external lobes of premolars nearly straight with no median buttresses. Hypocone of last superior molar very much reduced.

The two species of this genus, namely *T. validus* and *T. cultridens*, have their molar characters nearly identical, the specific differences being in their intermediate tubercles and in the form of the second superior premolar. Cope's species *P. vallidens* (at least the upper molars which he referred to that species) should be placed under *T. validus* Marsh.

The teeth in the genus *Telmatotherium* are easily distinguished from those of *Palaeosyops*, they have a square form, with high crowns and prominent cusps, the external V's are broad and angular, the anterior buttress is not prolonged, and the median one is large and widely constricted off, the external face of the teeth are provided with a prominent cingulum, outer face of premolars straight,

<sup>1</sup> Palaeontological Bulletin No. 11, p. 1, Jan. 31st, 1873.

and the second superior premolar may have a rudimentary or well defined internal cone. The premaxillaries are high and compressed, with an elongated median suture. They are very different from those of *Palaeosyops*, in which their form is short and depressed. The zygomatic arch in *Telmatotherium* is straighter and lighter than in *Palaeosyops*.

The following characters may define the two species of this genus:

**1. *Telmatotherium validus* Marsh.**

Second superior premolar with a well developed internal lobe, last upper molar without rudimentary hypocone.

The intermediate tubercles in this species are more developed than in *T. cultridens*, the first molar has a protoconule, the second has this tubercle also present, the third molar with both intermediate tubercles. The last two upper premolars have their internal cingula incomplete.

**2. *Telmatotherium cultridens* S. & O. (*Leurocephalus cultridens* S. & O.).**

Second superior premolar with rudimentary internal lobe, last superior molar with a rudimentary hypocone.

The intermediate tubercles in this species are very much reduced, the protoconules of the first upper molar only being present. The internal basal cingulum of the last two upper premolars is complete.

The two species above defined may be merely well marked varieties, but the material relating to them is not abundant, and we may leave them for the present as above given.

I shall leave for my final paper the treatment of the relationship between the genera and species in this family, and I will merely add that it includes two well marked forms of teeth: namely that of *Palaeosyops*, with low crowns and large intermediate tubercles, and that of *Telmatotherium* with very high crowns and reduced tubercles. It is the latter form of molar which I believe has led up directly to *Diplacodon* and not *Palaeosyops*, as generally stated, the latter genus having been the ancestor of *Telmatotherium*.

*Incertae sedis.*

***Palaeosyops hyognathus* S. & O.<sup>1</sup>**

Types.—Lower jaw No. 10,273 in Princeton Museum.

Symphysis extremely long and shallow, canines

<sup>1</sup> The Mammalia of the Uinta Formation, Trans. Am. Phil. Soc. N. S. Vol., 16, Aug. 1839, p. 513.

small and semiprocumbent. A long diastema anterior and posterior to premolar 1.

**Palaeosyops megarhinus** Earle.<sup>1</sup>

Type.—Skull No. 10,008 in Princeton Museum.

No diastema in superior dental series, canines very small and wide spreading, superior true molars without external cingulum, distal extremity of nasal expanded.

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<sup>1</sup> American Naturalist, Jan., 1891, p. 45.